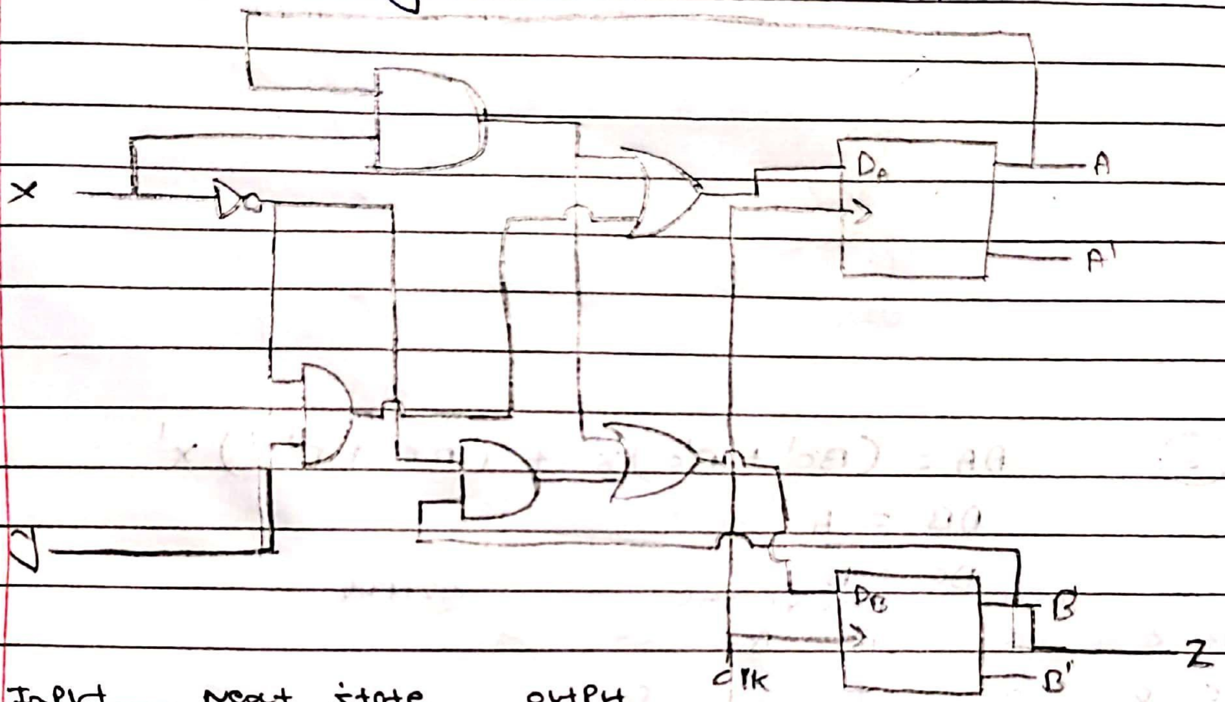
Assignment = 6

(i) $A(t+1) = x'y + xA$

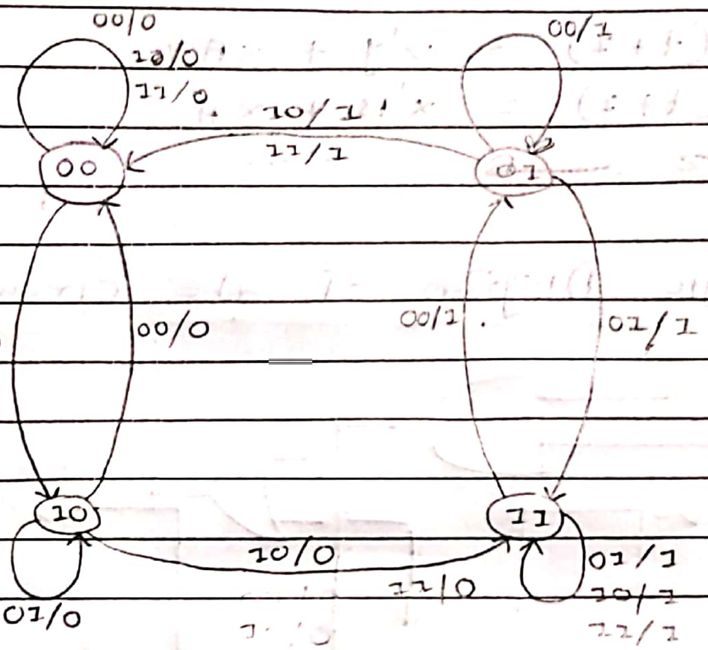
$B(t+1) = x'B + xA$

$z = B$

(a) Logic Diagram of the circuit



P.S.		Input		Next state		output
A	B	x	y	A+	B+	z
0	0	0	0	0	0	0
0	0	0	1	1	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	1	1
0	1	0	1	1	1	1
0	1	1	0	0	0	1
0	1	1	1	0	0	1
1	0	0	0	0	0	0
1	0	0	1	1	0	0
1	0	1	0	1	1	0
1	0	1	1	1	1	0
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

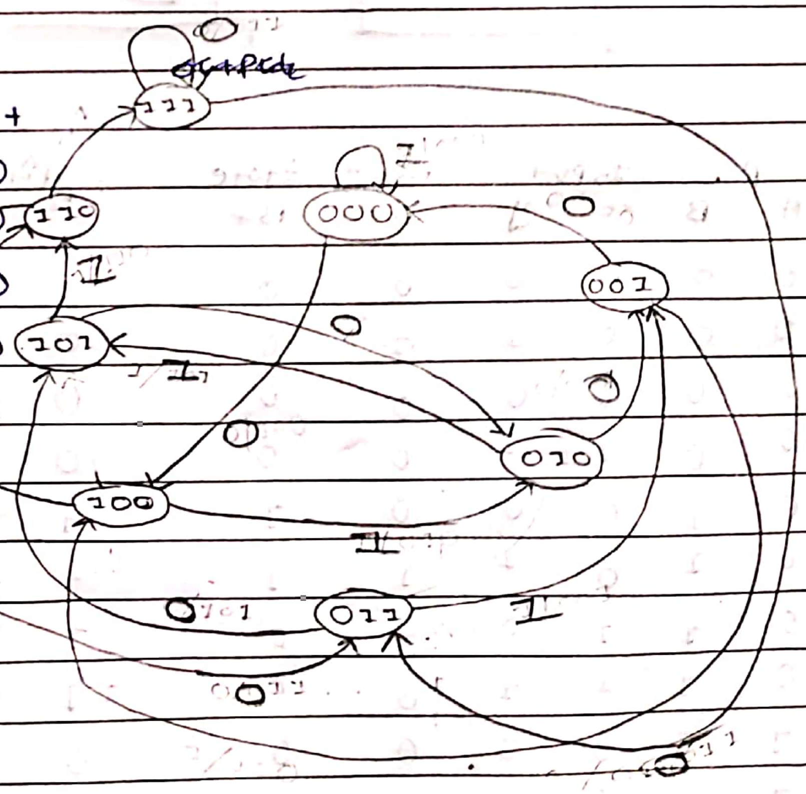


(2) $DA = (BC' + B'C)x + (BC + B'C')x'$

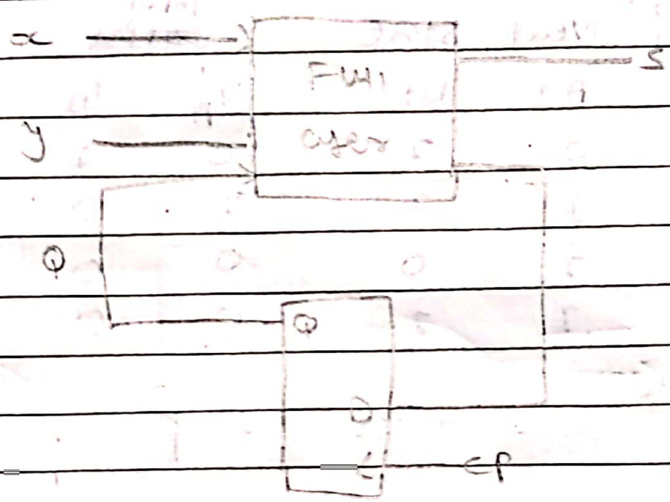
$DB = A$

$DC = B$

P.S.			Input	Next state		
A	B	C	x	A+	B+	C+
0	0	0	0	1	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	1	0	0
0	1	0	0	0	0	1
0	1	0	1	1	0	1
0	1	1	0	1	0	1
0	1	1	1	0	0	1
1	0	0	0	1	1	0
1	0	0	1	0	1	0
1	0	1	0	0	1	0
1	0	1	1	1	1	0
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	0	1	1

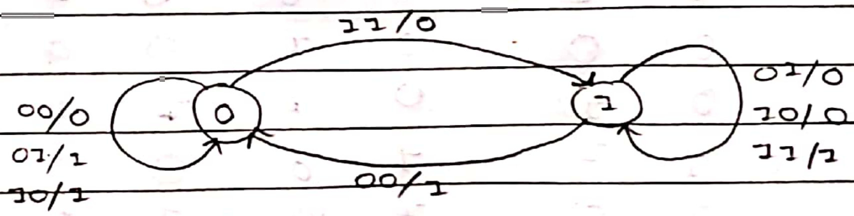


(3) It has a flip flop Input = x, y output S



State table:-

Present state:-	Input		Next state (carry)	output (sum)
Q	x	y	Q t	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1



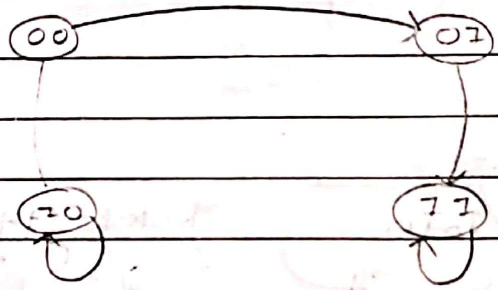
(4) Equation for circuit

$A(t+1) = A+B$

$B(t+1) = A'+B$

State table:-

Present state		Next state		input	
A	B	A+	B+	T_A	T_B
0	0	0	1	0	1
0	1	1	1	1	0
1	0	1	0	0	0
1	1	1	1	0	0

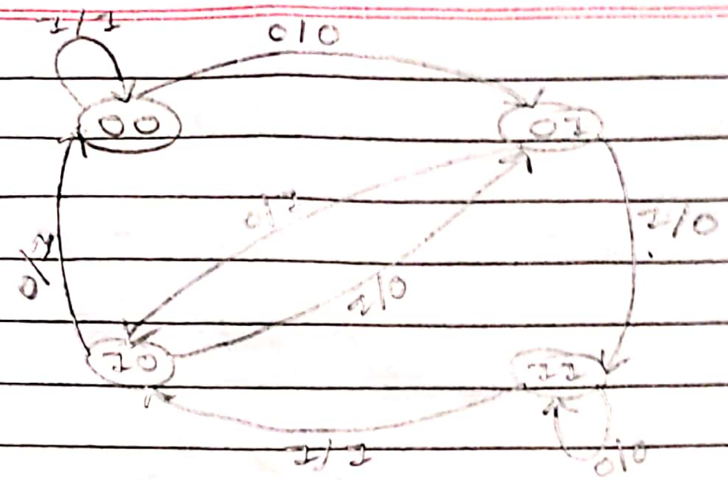


(5) Equation for circuit:-

$J_A = B \qquad K_A = B' \qquad y = (A \oplus x) \oplus B$

$J_B = (A \oplus x)' \qquad K_B = (A \oplus x)'$

P.S.		Input	N.S.						
A	B	x	A(+)	B(+)	J_A	K_A	J_B	K_B	output(y)
0	0	0	0	1	0	1	1	1	0
0	0	1	0	0	0	1	0	0	1
0	1	0	1	0	1	0	1	1	1
0	1	1	1	1	1	0	0	0	0
1	0	0	0	0	0	1	0	0	1
1	0	1	0	1	0	1	1	1	0
1	1	0	1	1	1	0	0	0	0
1	1	1	1	0	1	0	1	1	1



6) Here

$JA = (Bx + B'y')$ $\quad$ $KA = (B'xy')$

$JB = (A'x)$ $\quad$ $KB = A + (xy')$

$z = (Axy + Bx'y')$

$A(t+1) = J_A A' + K_A' A$ $\quad$ $B(t+1) = J_B B' + K_B' B$

Present state		Input		Flip flop inputs				Output	Next state	
A	B	x	y	J_A	K_A	J_B	K_B	z	A+	B+
0	0	0	0	1	0	0	0	0	1	0
0	0	0	1	0	0	0	0	0	0	0
0	0	1	0	1	1	1	1	0	1	1
0	0	1	1	0	0	1	0	0	0	1
0	1	0	0	0	0	0	0	1	0	1
0	1	0	1	0	0	0	0	0	0	1
0	1	1	0	1	0	1	1	0	1	0
0	1	1	1	1	0	1	0	0	1	1
1	0	0	0	1	0	0	1	0	1	0
1	0	0	1	0	0	0	1	0	1	0
1	0	1	0	0	1	0	1	0	0	0
1	0	1	1	0	0	0	1	1	1	0
1	1	0	0	0	0	0	1	1	1	0
1	1	0	1	0	0	0	1	0	1	0
1	1	1	0	1	0	0	1	0	1	0
1	1	1	1	1	0	0	1	1	1	0

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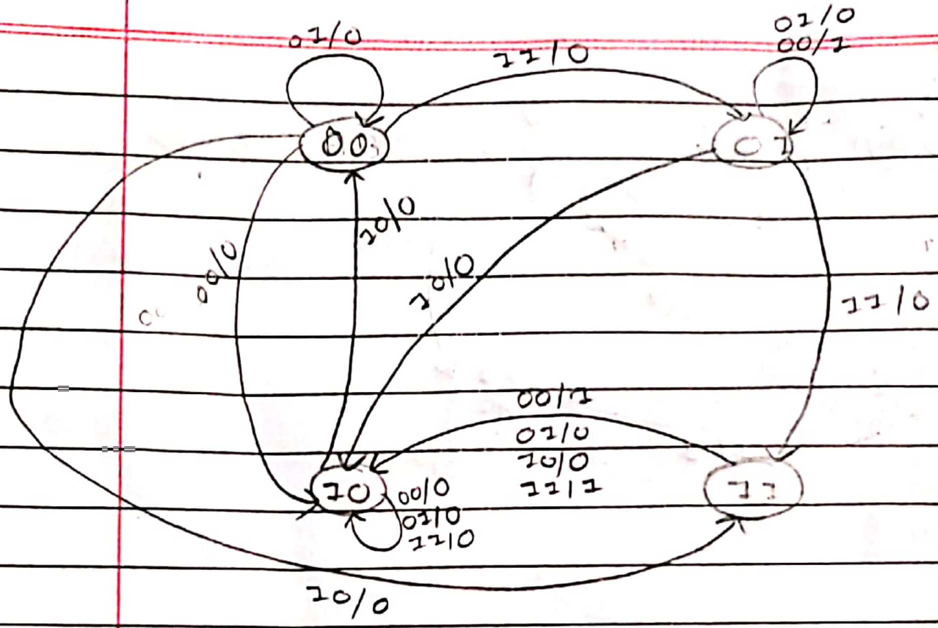
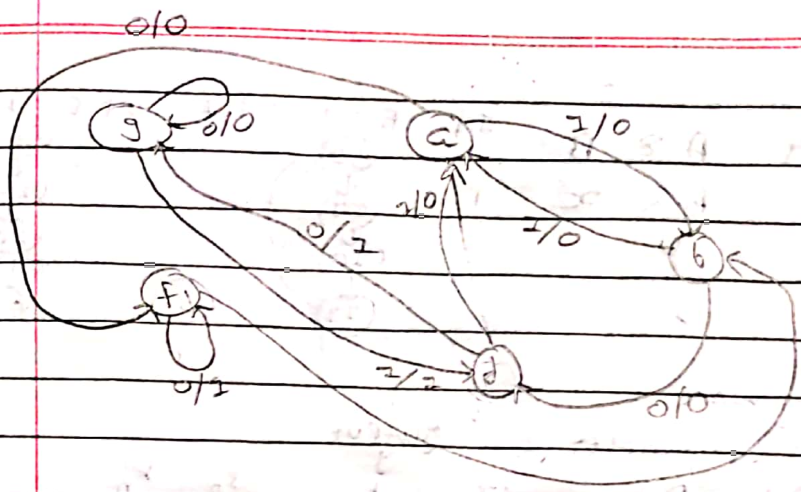


(7)

Present state	Next state $x=0$	Next state $x=1$	Output $x=0$	Output $x=1$
a	f	b	0	0
b	d	a	0	0
~~c~~	~~f~~	~~b~~	~~0~~	~~0~~
d	g	a	1	0
~~e~~	~~d~~	~~c~~	~~0~~	~~0~~
f	f	b	1	1
g	g	d	0	1
~~h~~	~~g~~	~~a~~	~~1~~	~~0~~

(i) h = d
(ii) e = b
(iii) c = a

Present state	Next state $x=0$	Next state $x=1$	Output $x=0$	Output $x=1$
a	f	b	0	0
b	d	a	0	0
d	g	a	1	0
f	f	b	1	1
g	g	d	0	1



(8) → Here $D(t+1) = T \oplus A$

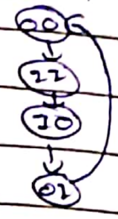
Present state	Input	Next State	~~Output~~
A	T	D	
0	0	0	
0	1	1	
1	0	1	
1	1	0	

→ Here the next stat of D is Equal to the T - flip flop's N.S. so we can say that for this circuit is D flip flop is equivalance of T flip flop.

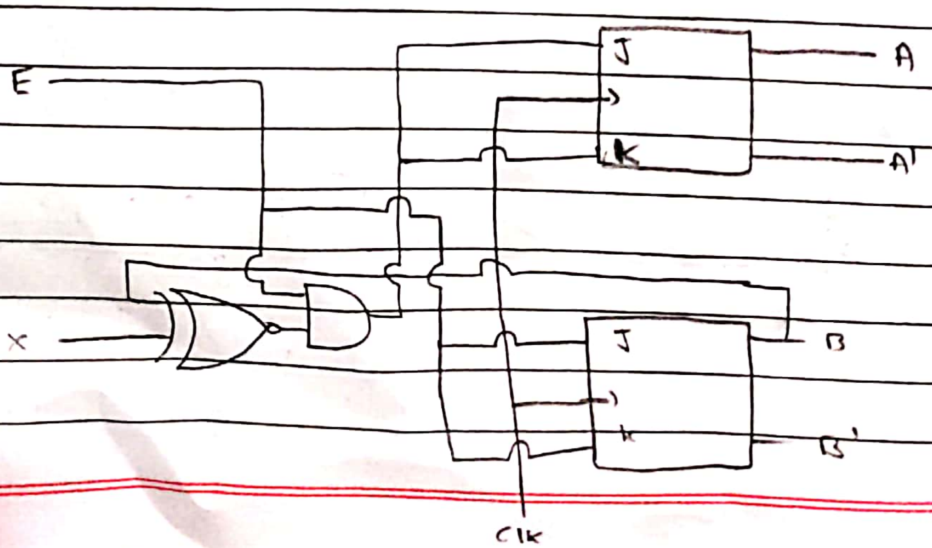
(9) → Flipflops A & B
Inputs E & x
Output y

If E = 1 x = 1

If E = 1 x = 0



P.S.		Inputs		next state		Output y			
A	B	E	x	A+	B+	J_A	K_A	J_B	K_B
0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	0	0	X	0	X
0	0	1	0	1	1	1	X	1	X
0	0	1	1	0	1	0	X	1	X
0	1	0	0	0	1	0	X	X	0
0	1	0	1	0	1	0	X	X	0
0	1	1	0	0	0	0	X	X	1
0	1	1	1	1	0	1	X	X	1
1	0	0	0	1	0	X	0	0	X
1	0	0	1	1	0	X	0	0	X
1	0	1	0	0	1	X	1	1	X
1	0	1	1	1	1	X	0	1	X
1	1	0	0	1	1	X	0	X	0
1	1	0	1	1	1	X	0	X	0
1	1	1	0	1	0	X	0	X	1
1	1	1	1	0	0	X	1	X	1



J_A

AB \ Ex	00	01	11	10
00				1
01			1	
11	x	x	x	x
10	x	x	x	x

$$J_A = BEx + B'Ex'$$
$$= E(Bx + B'x')$$
$$= E(B \odot x)$$

AB \ Ex	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11			1	
10				1

$$K_A = BEx + B'Ex'$$
$$= E(B \odot x)$$

AB \ Ex	00	01	11	10
00			1	1
01	x	x	x	x
11	x	x	x	x
10			1	1

$J_B = E$

AB \ Ex	00	01	11	10
00	x	x	x	x
01			1	1
11			1	1
10	x	x	x	x

$K_B = E$

(10) (a) Design the sequencial circuit using D-flip flops.

P.S. A	B	C	Next state $x=0$ ($A(t+1)\ B(t+1)\ C(t+1)$)	Next state $x=1$	Output $x=0$ y	Output $x=1$ y
0	0	0	011	100	0	1
0	0	1	001	100	0	1
0	1	0	010	000	0	1
0	1	1	001	010	0	1
1	0	0	010	011	0	0

We have to use don't care condition, i.e.

AB \ Cx	00	01	11	10
00		1	1	
01				
11	x	x	x	x
10	x	x	x	x

$$A(t+1) = A'B'x$$

AB \ Cx	00	01	11	10
00	1			
01	1		1	
11	x	x	x	x
10	1	1	x	x

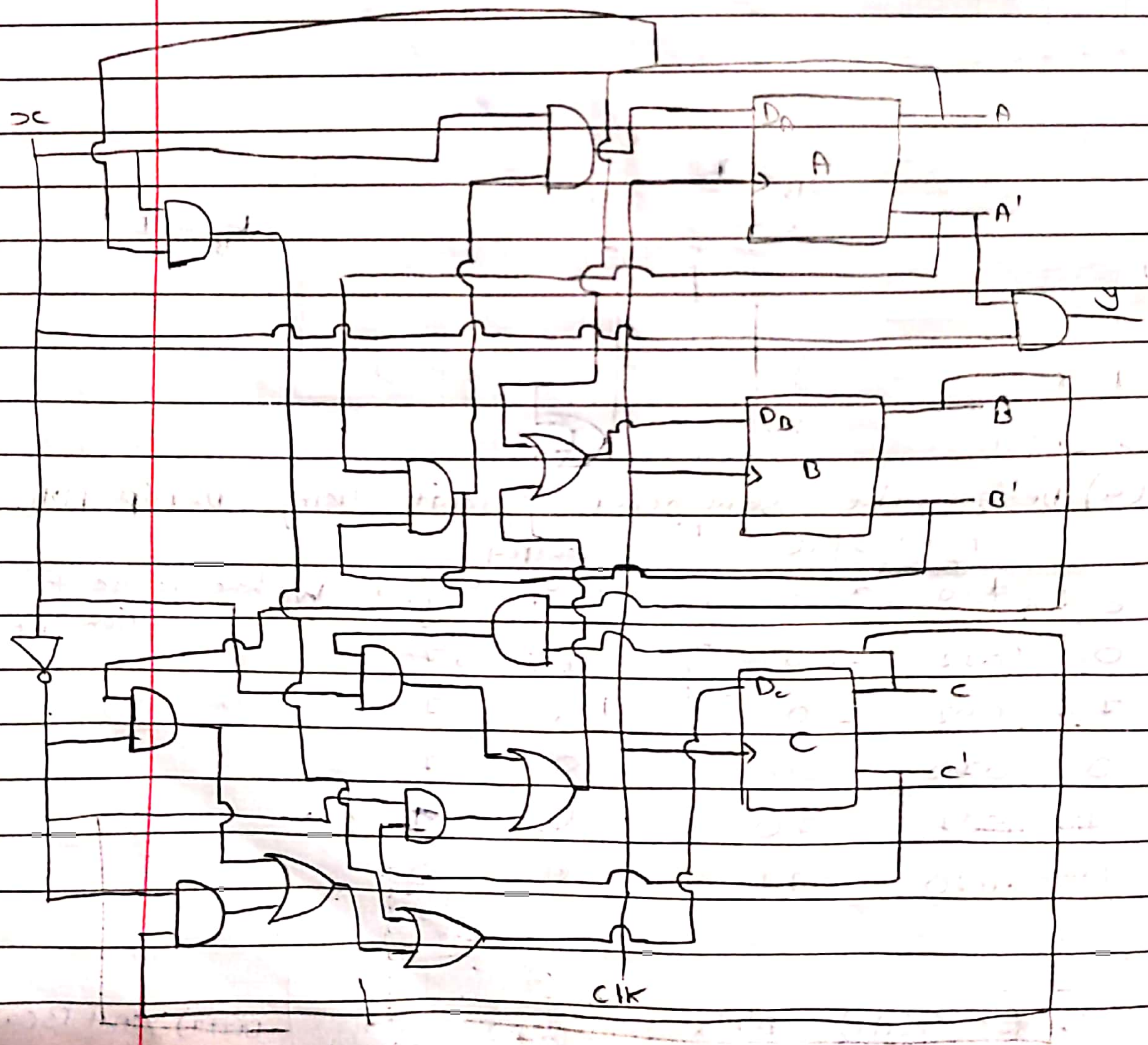
$$B(t+1) = A + BCx + C'x'$$

AB \ Cx	00	01	11	10
00	1			1
01				1
11	X	X	X	X
10		1	X	X

$$C(t+1) = \cancel{B'C'x' + A + Cx'}$$
$$= Ax + Cx' + A'B'x'$$

AB \ Cx	00	01	11	10
00		1	1	
01		1	1	
11	X	X	X	X
10			X	X

$$y = A'x$$



(b) Design the sequencial circuit using JK Flip flops

P. S.			Input	Output	Next state								
A	B	C	x	y	A+	B+	C+	J_A	K_A	J_B	K_B	J_C	K_C
0	0	0	0	0	0	1	1	0	X	1	X	1	X
0	0	0	1	1	1	0	0	1	X	0	X	0	X
0	0	1	0	0	0	0	1	0	X	0	X	X	0
0	0	1	1	1	1	0	0	1	X	0	X	X	1
0	1	0	0	0	0	1	0	0	X	X	0	0	X
0	1	0	1	1	0	0	0	0	X	X	1	0	X
0	1	1	0	0	0	0	1	0	X	X	1	X	0
0	1	1	1	1	0	1	0	0	X	X	0	X	1
1	0	0	0	0	0	1	0	X	1	1	X	0	X
1	0	0	1	0	0	1	1	X	1	1	X	1	X

AB \ Cx	00	01	11	10
00		1	1	
01				
11	X	X	X	X
10	X	X	X	X

$J_A = A'B'x$

AB \ Cx	00	01	11	10
00	X	X	X	X
01	X	X	X	X
11	X	X	X	X
10	1	1	X	X

$K_A = 1$

AB \ Cx	00	01	11	10
00	1			
01	X	X	X	X
11	X	X	X	X
10	1	1	X	X

$J_B = A + C'x'$

AB \ Cx	00	01	11	10
00	X	X	X	X
01		1		1
11	X	X	X	X
10	X	X	X	X

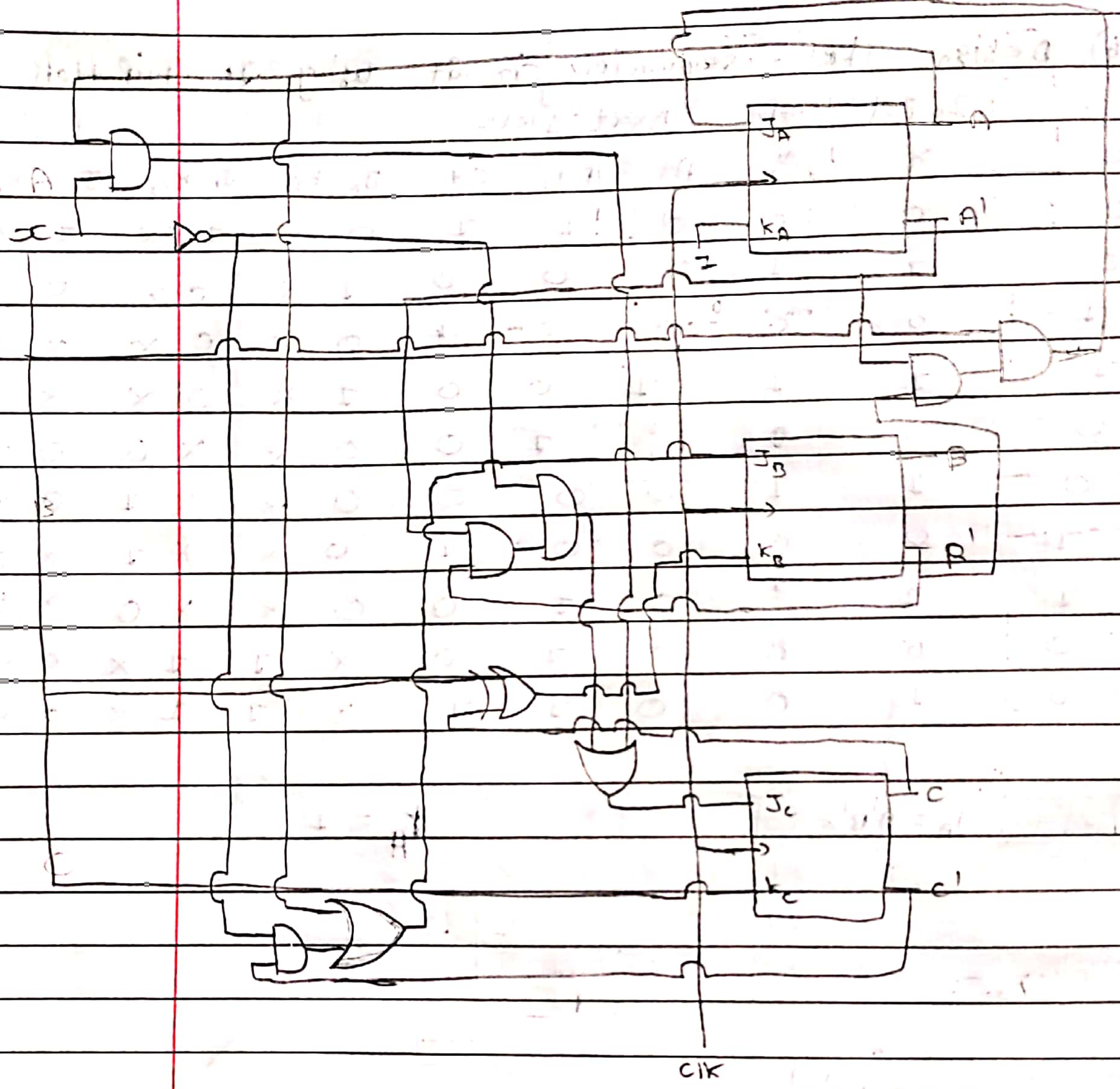
$K_B = Cx' + C'x = C \oplus x$

AB \ Cx	00	01	11	10
00	1		X	X
01			X	X
11	X	X	X	X
10		1	X	X

$J_C = Ax + A'B'x'$

AB \ Cx	00	01	11	10
00	X	X	1	
01	X	X	1	
11	X	X	X	X
10	X	X	X	X

$K_C = x$



(11) Design 4 bit Counter using JK flip-flop.

P.S. A	B	C	D	N.S. A^+	B^+	C^+	D^+	J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D
0	0	0	0	0	0	0	1	0	x	0	x	0	x	1	x
0	0	0	1	0	0	1	0	0	x	0	x	1	x	x	1
0	0	1	0	0	0	1	1	0	x	0	x	x	0	1	x
0	0	1	1	0	1	0	0	0	x	1	x	x	1	x	1
0	1	0	0	0	1	0	1	0	x	x	0	0	x	1	x
0	1	0	1	0	1	1	0	0	x	x	0	1	x	x	1
0	1	1	0	0	1	1	1	0	x	x	0	x	0	1	x
0	1	1	1	1	0	0	0	1	x	x	1	x	1	x	1
1	0	0	0	1	0	0	1	x	0	[illegible]	x	0	x	1	x
1	0	0	1	1	0	1	0	x	0	[illegible]	x	1	x	x	1
1	0	1	0	1	0	1	1	x	0	x	x	x	0	1	x
1	0	1	1	1	1	0	0	x	0	1	x	x	1	x	1
1	1	0	0	1	1	0	1	x	0	x	0	0	x	1	x
1	1	0	1	1	1	1	0	x	0	x	0	1	x	x	1
1	1	1	0	1	1	1	1	x	0	x	0	x	0	1	x
1	1	1	1	0	0	0	0	x	1	x	1	x	1	x	1

AB \ CD	00	01	11	10
00				
01			1	
11	x	x	x	x
10	x	x	x	x

$J_A = BCD$

AB \ CD	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11			1	
10				

$K_A = BCD$

AB \ CD	00	01	11	10
00			1	
01	x	x	x	x
11	x	x	x	x
10			1	

$J_B = CD$

$K_B = CD$

AB \ CD	00	01	11	10
00		1	x	x
01		1	x	x
11		1	x	x
10		1	x	x

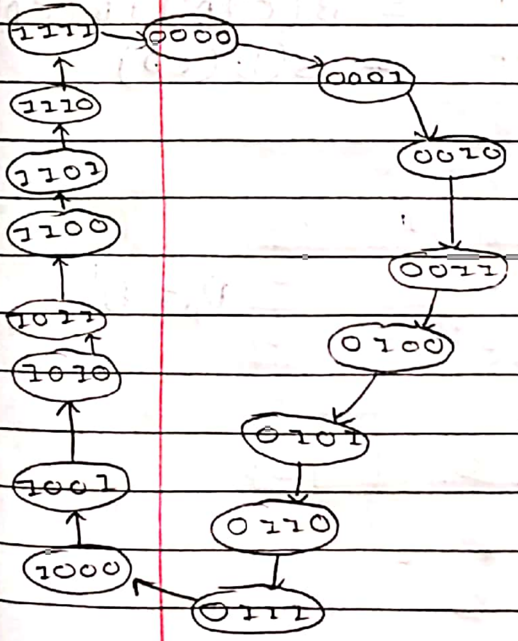
$J_C = D$

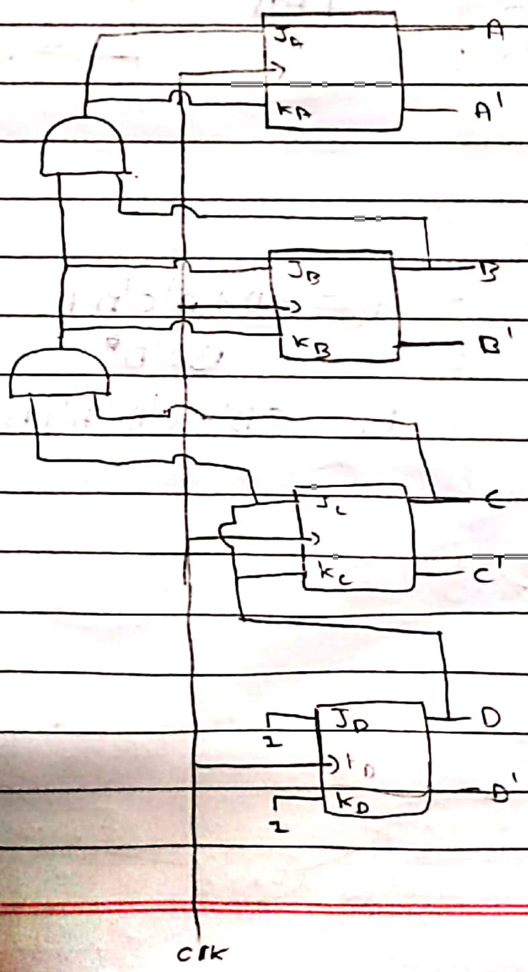
$K_C = D$

AB \ CD	00	01	11	10
00	1	x	x	1
01	1	x	x	1
11	1	x	x	1
10	1	x	x	1

$J_D = 1$

$K_D = 1$





12 Design BCD counter using D flip flop

P.S. A	B	C	D	N.S. A+	B+	C+	D+	Flip flop input D_A	D_B	D_C	D_D
0	0	0	0	0	0	0	1	0	0	0	1
0	0	0	1	0	0	1	0	0	0	1	0
0	0	1	0	0	0	1	1	0	0	1	1
0	0	1	1	0	1	0	0	0	1	0	0
0	1	0	0	0	1	0	1	0	1	0	1
0	1	0	1	0	1	1	0	0	1	1	0
0	1	1	0	0	1	1	1	0	1	1	1
0	1	1	1	1	0	0	0	1	0	0	0
1	0	0	0	1	0	0	1	1	0	0	1
1	0	0	1	0	0	0	0	0	0	0	0

AB \ CD	00	01	11	10
00				
01			1	
11	x	x	x	x
10	1		x	x

$D_A = BCD + AD'$

AB \ CD	00	01	11	10
00			1	
01	1	1		1
11	x	x	x	x
10			x	x

$D_B = BC' + BD' + B'CD$

$= B(C' + D') + B'(CD)$

$= B \oplus (CD)$

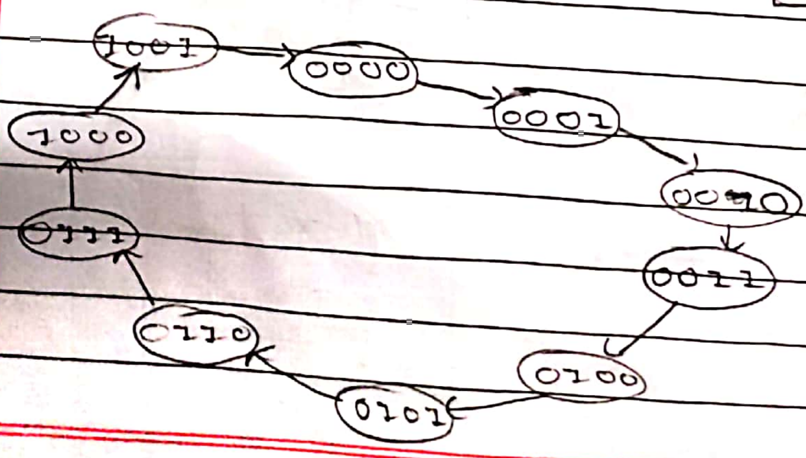
AB \ CD	00	01	11	10
00		1		1
01		1		1
11	x	x	x	x
10			x	x

$D_C = CD' + A'C'D + BC'D$

$D_C = CD' + C'D(A' + B)$

AB \ CD	00	01	11	10
00	1			1
01	1			1
11	x	x	x	x
10	1		x	x

$D_D = D'$



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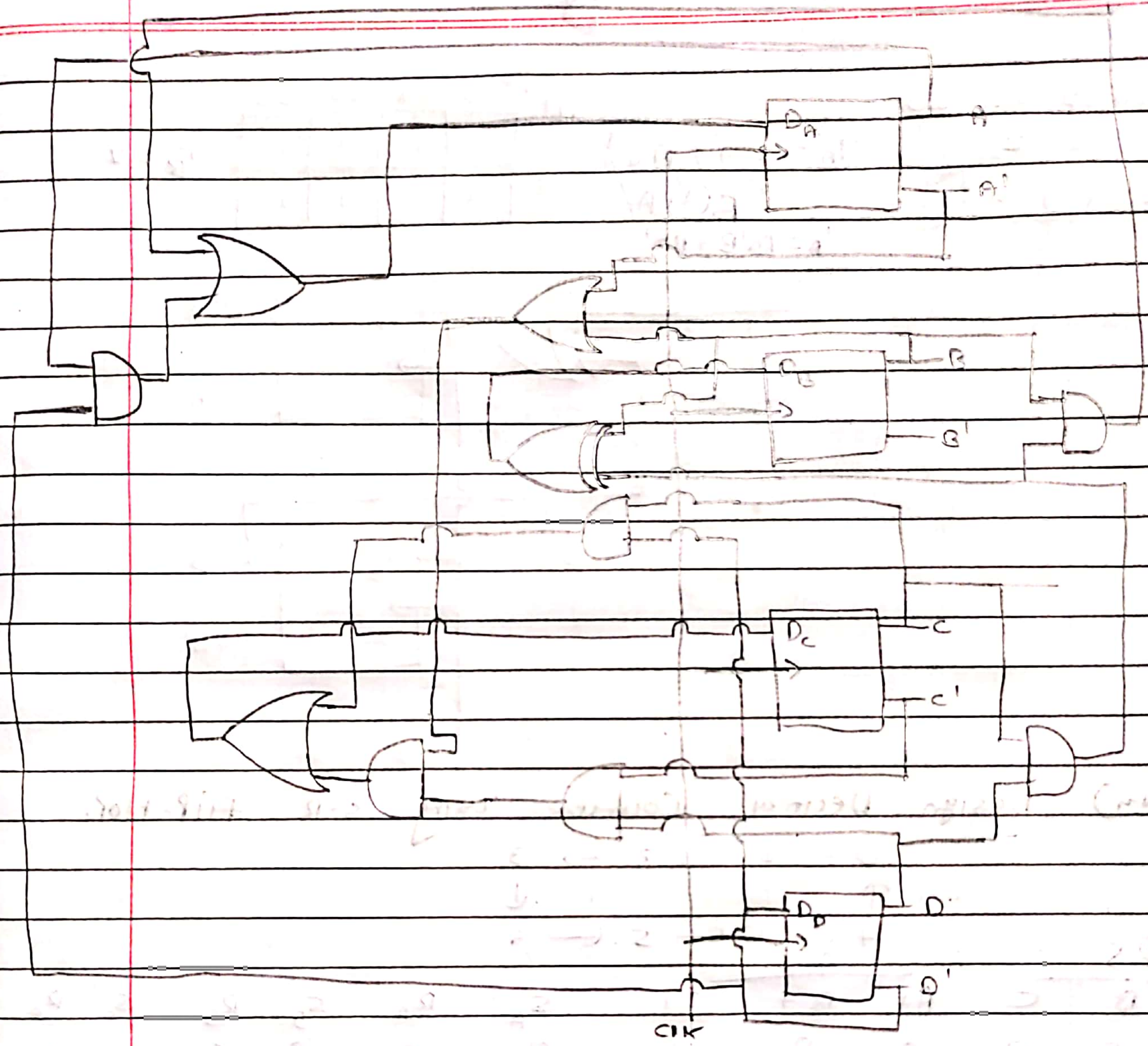


(13) Design mod-4 Counter using T flip-flop.

MODE SELECT	(M)	PRESENT STATE Q_A	Q_B	NEXT STATE Q_{A+1}	Q_{B+1}	INPUTS OF F.F. T_A	T_B
0	0	0	0	0	1	0	1
1	0	0	1	1	0	1	1
2	0	1	0	1	1	0	1
3	0	1	1	0	0	1	1
7	1	1	1	1	0	0	1
6	1	1	0	0	1	1	1
5	1	0	1	0	0	0	1
4	1	0	0	1	1	1	1

Scanned with CamScanner

M \ AB	00	01	11	10
00		1	1	
01	1	1	1	1
11				
10				

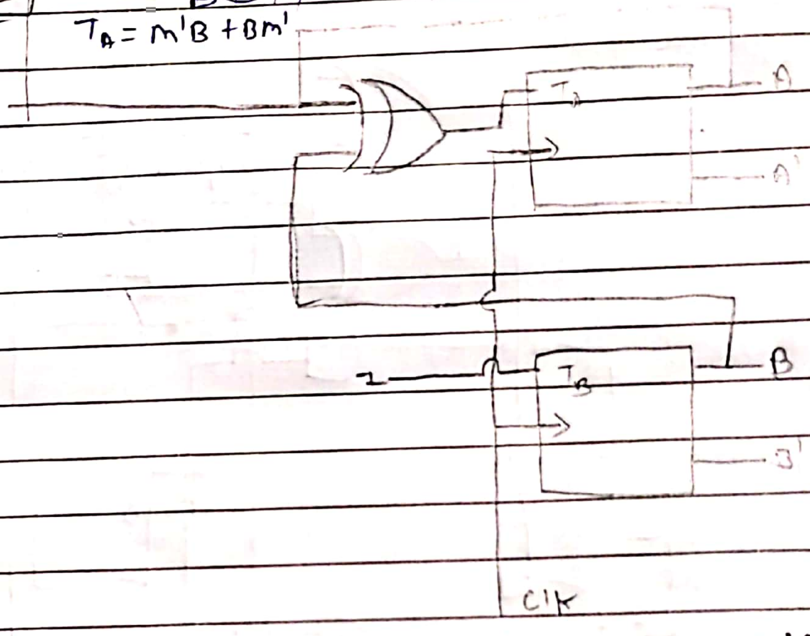
~~$T_A = CA' + AC$~~

~~$= B \oplus A$~~

$T_A = M'B + BM'$

AM \ AB	00	01	11	10
0	1	1	1	1
1	1	1	1	1

$T_B = 1$



(Q4) Design Decimal Counter using S-R flip-flop.

0 → 1 → 2 → 3
↑ ↓
7 ← 6 ← 5 ← 4

P.S.			N.S.								
A	B	C	A+	B+	C+	S_A	R_A	S_B	R_B	S_C	R_C
0	0	0	0	0	1	0	X	0	X	1	0
0	0	1	0	1	0	0	X	1	0	0	1
0	1	0	0	1	1	0	X	X	0	1	0
0	1	1	1	0	0	1	0	0	1	0	1
1	0	0	1	0	1	X	0	0	X	1	0
1	0	1	1	1	0	X	0	1	0	0	1
1	1	0	1	1	1	X	0	X	0	1	0
1	1	1	0	0	0	0	1	0	1	0	1

A \ BC	00	01	11	10
0			1	
1	X	X		X

$S_A = BCA'$

A \ BC	00	01	11	10
0		1		X
1		1		X

$S_B = B'C$

A \ BC	00	01	11	10
0	X	X		X
1			1	

$R_A = ABC$

A \ BC	00	01	11	10
0	X		1	
1	X		1	

$R_B = BC$

A \ BC	00	01	11	10
0	1			1
1	1			1

$S_c = C'$

A \ BC	00	01	11	10
0		1	1	
1		1	1	

$R_c = C$